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LOW-COST DIGITAL READOUT FOR LABORATORY INSTRUMENTS

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LOW-COST DIGITAL READOUT FOR LABORATORY INSTRUMENTS[1]

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INTRODUCTION

Digital readout of laboratory instruments has become the standard of accuracy in recent years in lieu of conventional panel meters and recorders. Digital meters normally have high accuracy capability and unexcelled readability. These two factors are mandatory for instruments used by scientists and engineers to gain precise scientific data. With the recent availability of relatively low-cost digital panel meters, it is possible to incorporate direct digital readout into almost any laboratory instrument which utilizes a conventional panel meter or potentiometric recorder as an indicator. A digital millivolt meter can be connected to any instrument which has an output for a D.C. millivolt recorder without modifying the instrument. Since instruments of this type are usually designed with an output for a recorder with a range of from 0 to 10 or 0 to 100 mv., the millivolt meter described here merely has to be connected in lieu of a recorder. The millivolt meter may also be connected to electronic laboratory instruments which do not have recorder outputs by modifying detector indicator circuit.

SPECIFIC INFORMATION

The digital D.C. millivolt meter constructed in our laboratory uses a Triplett[3] 3 1/2-digit panel meter. Meters of this type utilize three counting digits together with one most significant digit which displays either blank or one. The Triplett panel meter has a 0 to ± 19.99 mv. D.C. range including automatic sign change. The panel meter utilizes a floating input with automatic blanking on any input voltage which exceeds the maximum rated input. Blanking of the three least significant digits is an immediate indication that input voltage is excessive. This panel meter has an accuracy of 0.1 percent of reading ± 1 digit at +23° C. ± 1° C., with a temperature coefficient of ±(0.01 percent of reading +0.01 percent of scale)/1° C.

Additional circuitry, as shown on the schematic (fig. 1), converts the 19.99 mv. digital panel meter into a laboratory quality, three-range (0 to 19.99, 0 to 199.9, and 0 to 1,999. mv.) digital meter with a calibrated input section.

The following parts are required:

M1-digital meter, 10 mv. Triplett model 5020
R1-250K 1/2w. linear taper variable resistor
R2-100K 1/4w. linear taper variable resistor
R3-100K 1/4w. linear taper variable resistor
S1-DPST, Alco MST - 105D toggle switch
S2-DP 4-position, 2-section rotary switch
S3-DP 2-position, 1-section rotary switch

Miscellaneous:

LMB, W-1C enclosure
3-wire power cord
3 knobs
2 1/4-inch I.D. rubber grommets
4-foot shielded input lead

The shunt, R1, is a series-type, panel-mounted variable resistor. The D.C. millivolt meter input is calibrated when R1 is in the zero resistance position.

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[3] Trade names are used in this publication solely to provide specific information. Mention of a trade name does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture or an endorsement by the Department over other products not mentioned.

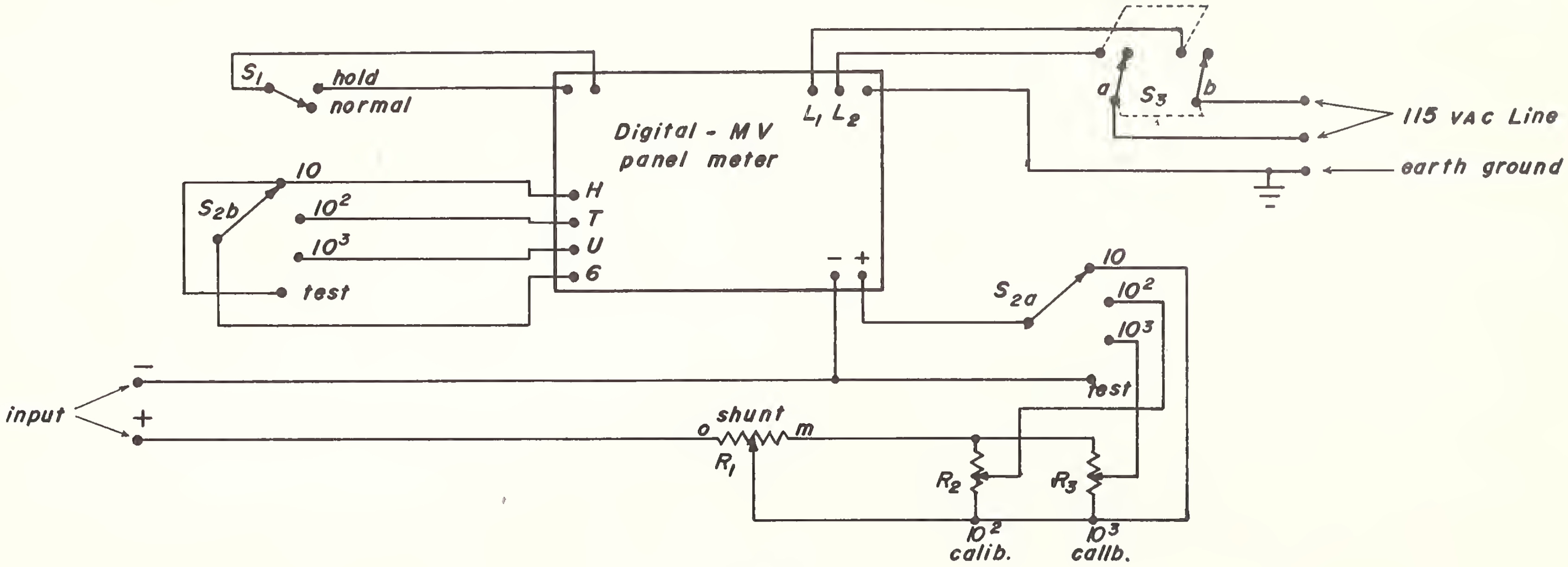

Figure 1.–Diagram of circuitry used to convert digital millivolt panel meter.

Variable resistors R2 and R3 are calibration resistors for the 10^2 and 10^3 ranges, respectively. These resistors comprise divider networks and are adjusted for correct meter readings on their respective ranges. Input, hold, and switching connections are wired to tie points provided on the panel meter (fig. 2). The digital panel meter schematic and tie points are given in the manual supplied with each panel meter.

Switch S2 has two functions (fig. 1). Section *a* is used as a range switch with one position being a zero input, calibration test. Section *b* is used to switch the decimal point to the proper position. Switch S1 in the closed position causes the meter to hold a single reading, present when the switch is closed, and in the open position allows the meter to count normally. Switch S3 is used to connect or disconnect both sides of the 115 V.A.C. (volts alternating current) powerline to the millivolt meter circuit.

The millivolt meter may be connected to an instrument which does not have a recorder output in the following manner. A 1-megohm variable resistor must be wired in parallel with the existing instrument detector indicator (fig. 3). The 1-megohm resistor is adjusted with the instrument detector operating at maximum output. While the voltage at the variable tap is being measured, the resistor should be adjusted and the voltage set to correspond with the maximum input to the millivolt meter on the range to be used.

The circuitry required, in addition to the digital panel meter, is relatively simple and very reliable. The completed instrument (fig. 4) has been used as the readout device for an atomic absorption spectro-photometer with excellent results. The millivolt meter is more stable than the detector output of the spectrophotometer. Therefore, when using the meter with this instrument, it is advantageous to operate the meter in the 10^2 range, eliminating the hundredth digit cycling, as the meter will indicate only to the nearest 10th of a millivolt in this mode.

The total cost of the completed digital millivolt meter is approximately \$255, including labor. Construction time is approximately 2.5 hours. The low price of this millivolt meter should be attractive to many scientists and engineers who need a readout device with high accuracy and excellent readability on various types of laboratory instruments.

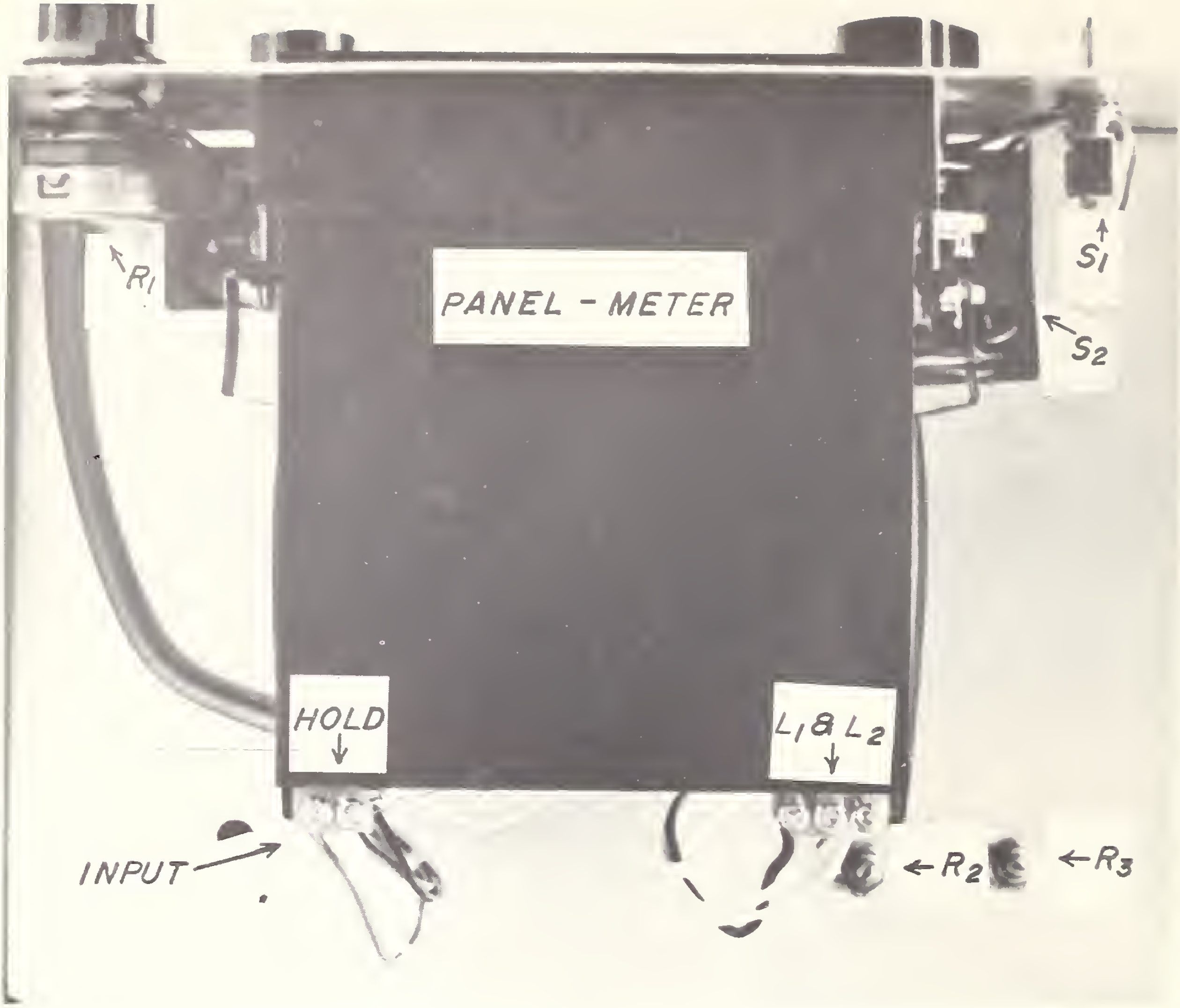

Figure 2.–Inside view of digital millivolt meter, showing simplicity of assembly layout.

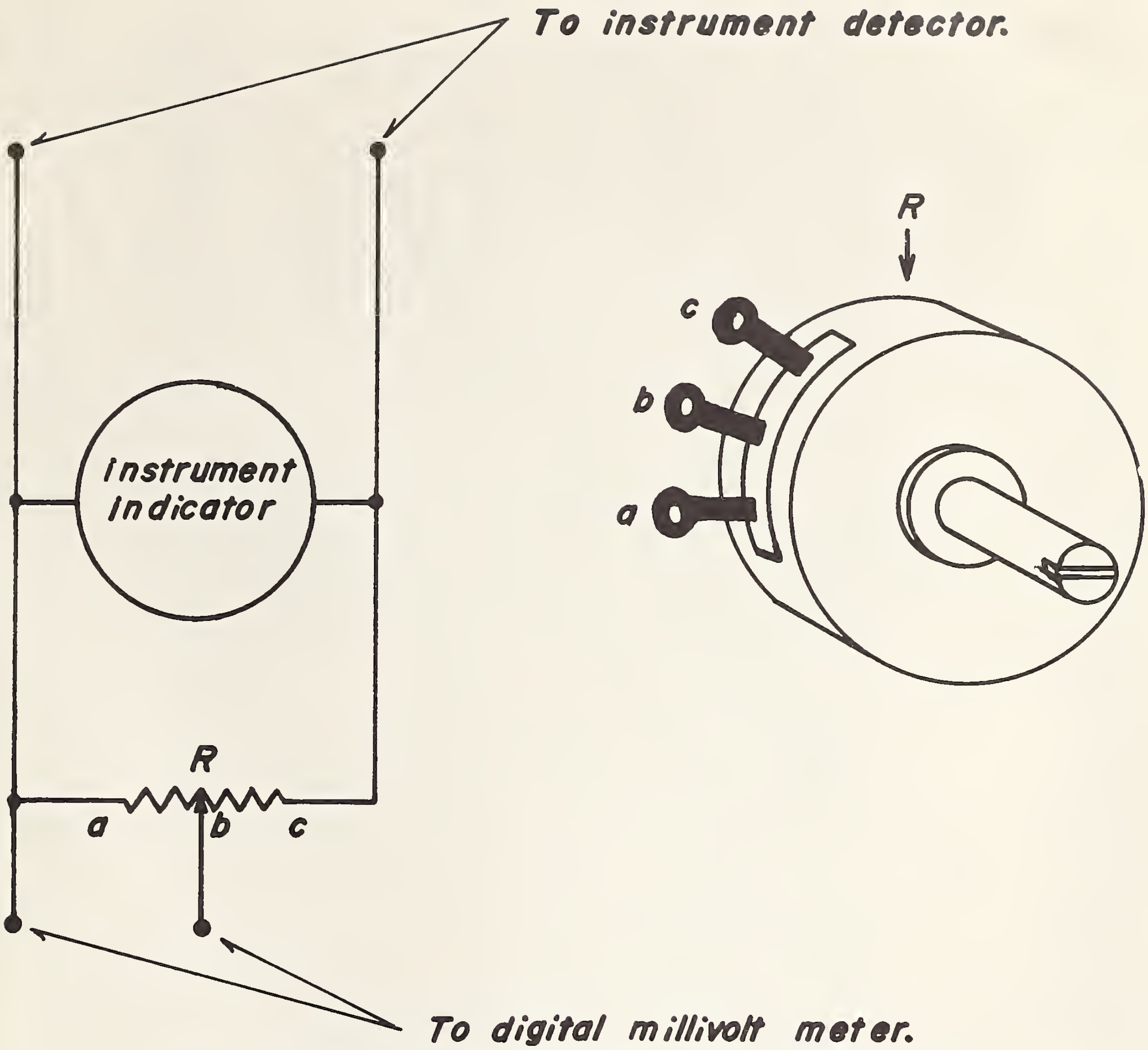

Figure 3.–Diagram showing direct connection of millivolt meter to instrument indicator circuit.

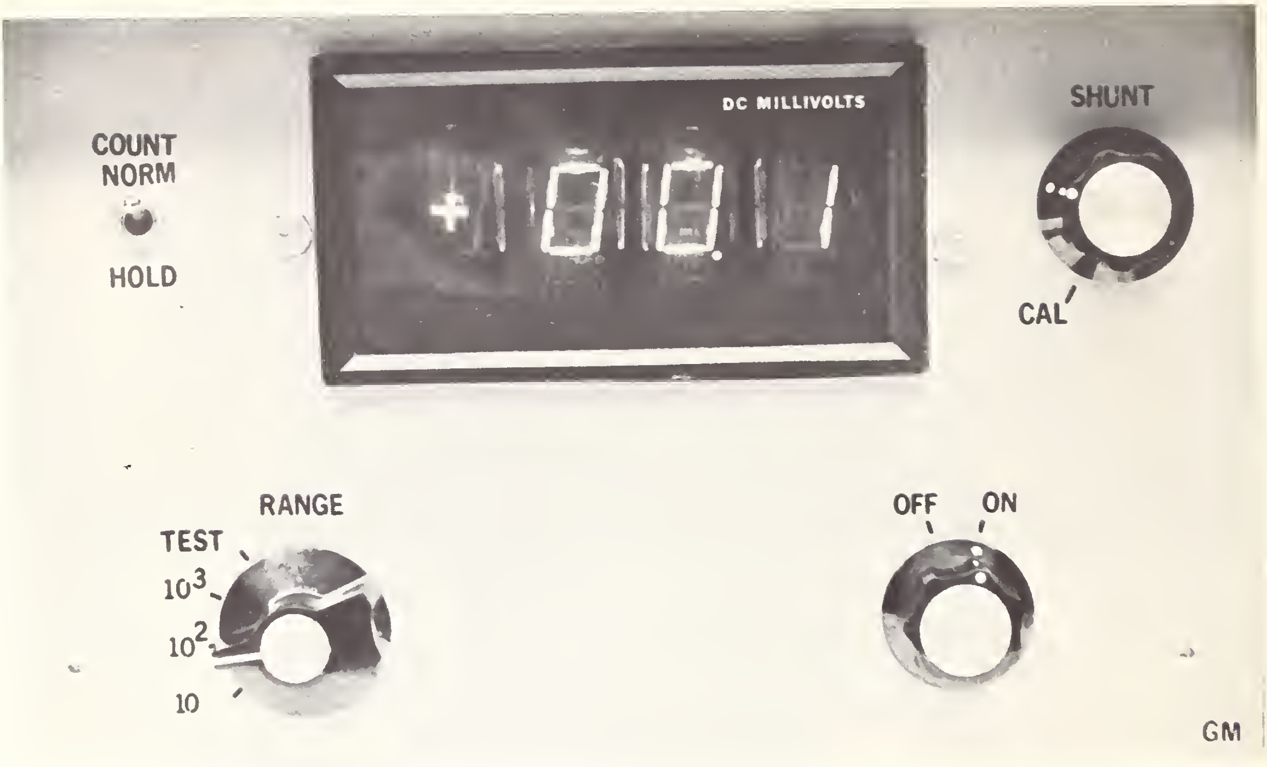

Figure 4.–Front panel view of digital millivolt meter showing controls.